

Mooring Buoy Installation & Maintenance Handbook



**The Coral Reef Alliance:
Coral Parks Program
Education Series**

Introduction

Over the past ten or twenty years, the awareness that mooring buoys are necessary to protect coral reefs for both environmental and economic reasons has grown considerably. Both governments and marine tour operations have invested time and money into putting into place permanent moorings to protect their local reefs.

The information contained in this booklet is an attempt to synthesize some of the written material available as well as some of the lessons learned from conservationists in both the public and private sectors. Just as every reef and community have their own particular characteristics, so do mooring installations. We know that there are differing opinions on the subjects contained in this manual. We also realize that there is a good bit of knowledge out in the field and elsewhere that is not contained in here. We encourage you to let us know what we should change and what else we can include, so that future editions of this handbook will be better and so that this practical series of handbooks can serve as a way to collect and disseminate the hard learned lessons by mooring installers in coral reef areas.

Please send your comments, stories and information to:

The Coral Reef Alliance
417 Montgomery St. Ste 205
San Francisco, CA 94104
Tel: 415-834-0900
Fax: 415-834-0999
Email: info@coral.org
Web: www.coral.org

Acknowledgements

We would like to thank those who have directly and indirectly contributed to the production of this publication: Dave Merrill, Suwan Pitaksintorn, Kathleen Auterio, Danita Dulce, Dave Read, Reef Relief, Green Reef, Soufriere Marine Management Area. We would also like to acknowledge the Project AWARE Foundation for previously publishing the Mooring Buoy Planning Guide which was extremely helpful. This is another good resource for mooring installations and can be downloaded from the Project AWARE website.

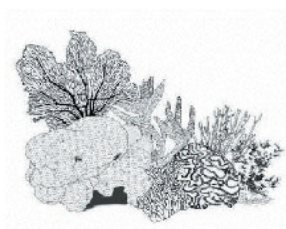


Table of contents

Part I: Mooring Buoys: A reef-saving alternative to anchoring	3
How anchors damage coral reefs	4
What anchor damage means to coral reef health	5
Can a reef recover from anchor damage?	6
What declining reef health means to local businesses and communities	7
Benefits of moorings	8
Other management options	9
 Part II: Planning a successful mooring program	 11
Mooring Buoy Planning Guide & Checklist	12
Stakeholder involvement	13
Ways to involve stakeholders	15
Navigating bureaucracy	17
Limiting your liability	18
User and private mooring permits	19
Why have rules?	20
Mooring site selection	22
Mooring buoy parts & options	25
Mooring Anchors: Different types	26
Which anchor to choose?	27
Downline : The connection to the surface	31
Buoys	32
Surface lines	33
Other, cheaper options	34
Maintenance: Taking care of your moorings	35
Funding installation costs	36
Calculating costs	37
Creating a funding plan	38
Keeping costs down	39
Funding sources	40

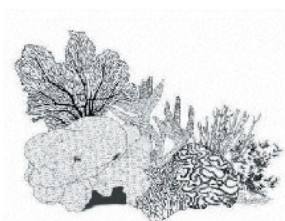
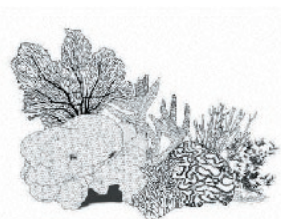


Table of contents (continued)

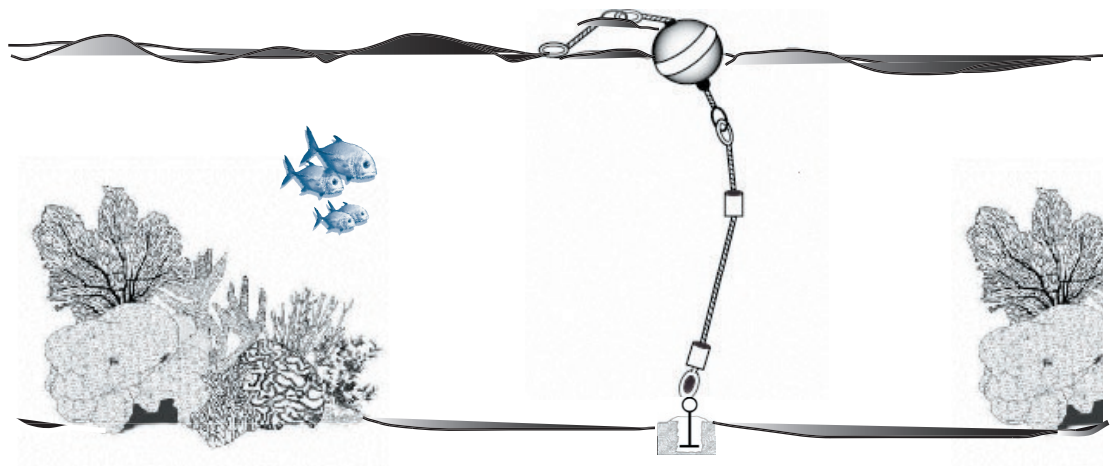
Part III: Installing moorings	43
General installation tips	44
Installation Overview: Drilled moorings	45
Installation Overview: Manta Ray anchors	47
Installation Overview: Helix anchors	49
Preparing the Tackle: Downlines, surface lines and buoys	51
 Part IV: Maintenance	 53
Creating a maintenance program	54
Mooring Buoy Disappearance and Theft:	
Special strategies	55
Finding funding for maintenance	56
Funding sources for maintenance	58
 Part V: Appendix	 60
Mooring resources	60
Glossary	62



Mooring Buoys: A reef-saving alternative to anchoring

Every year, the use of anchors for mooring commercial and recreational boats causes millions of dollars in damage to coral reefs around the world. Mooring buoys are a simple solution that protect coral reefs and the businesses that depend on them. They are an essential part of any coral park management plan.

A mooring buoy is a device that protects coral reefs by allowing boats to easily fix their position without anchoring. By using buoys, boats can tie to a line that is permanently connected to the sea floor. Used by coral parks and tour operators in every region of the world, buoys have been effectively implemented to minimize anchor damage and protect coral reefs. While mooring buoys may not be suitable for all locations, they are by far the best means for preventing the damage caused by anchors.



How anchors damage coral reefs

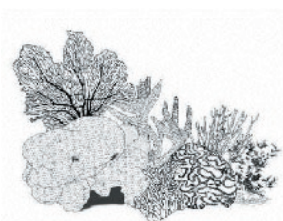
Anchors damage reefs by:

- Destroying corals.
- Preventing new coral growth.
- Making them vulnerable to disease.
- Increasing sedimentation.

Anchoring on or even near a coral reef can cause immediate, visible damage which impacts the health of the reef and also its appeal to tourists. Anchoring can:

- **Destroy corals.** Anchors damage coral reefs by crushing and killing the corals on which they fall.
- **Prevent new corals from growing.** Repeated anchor drops or large anchors will break up the underlying reef (coral substrate) and prevent new corals from developing.
- **Create scarring and make corals vulnerable to disease.** Anchor chains can strip the live tissue off of corals, causing widespread scarring, and leaving the injured corals open to infection.
- **Other harmful effects.** Anchoring also causes a number of other harmful effects such as clouding the water with disturbed sediment that can choke corals and limit the amount of sunlight that corals' symbiotic algae require to make food.

Some coral forms are more likely to be broken by anchors than others. Branching forms and plate-like corals are among those most likely to be destroyed than massive corals.



Q: Isn't anchoring in sand good enough?

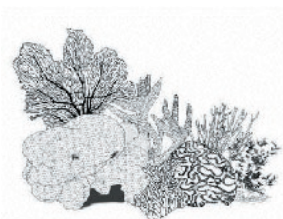
A: Attempting to anchor in sand near a coral reef can lead to accidental damage, unless you are anchoring in specifically designated areas. While the intentions may be good, underlying coral may not be visible from the surface and the boat may shift position before the anchor reaches the sea floor, or if the anchor is not entirely secure it could be dragged into a coral reef area. Even if the anchor itself does not damage the coral, the anchor chain could, if it comes into contact with the coral. Anchoring near a reef also can be setting a bad example, leading other boaters to believe that it is okay to anchor in the near vicinity—your anchor may land safely in sand, but theirs could end up on the reef.

What anchor damage means to coral reef health

Impacts of anchor damage on coral reef include:

- Fewer corals.
- Fewer fish.
- Fewer new corals.
- More stress.
- More algae growth.
- Cloudy water (lack of sunlight for corals).

Anchors stir up so much sediment that they can reduce visibility in the water from 60 to 1 meter!



Some of the effects of anchoring on and around coral reefs include:

- **Fewer living corals.** Anchors and anchor chains scar coral reefs as they break and crush coral colonies and other reef animals.
- **Fewer fish.** Degraded coral reef habitat reduces the numbers and variety of fish that are a significant attraction for tourists.
- **Fewer new corals.** When a coral reef is reduced to rubble by irresponsible anchoring, it is impossible for new corals to grow and the reef will further decline. Tourists, especially divers, will not return to reefs that have been severely damaged.
- **More stressed corals.** Remaining corals will be stressed and therefore more vulnerable to associated problems such as bleaching events and diseases.
- **More algae growth.** The sediment-filled anchor scars are poor environments for new coral growth, but good environments for fast growing algae, which may take the place of corals.
- **Cloudy water.** Anchoring can also cause an increase in sand and sediment in the water, making once clear water appear cloudy or murky. This prevents corals from getting the sunlight they need to survive.



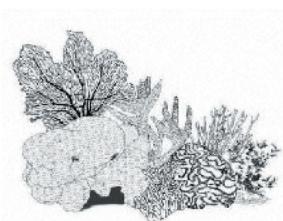
Photo: McManus, John W.

Corals are damaged regardless of anchor size.

Recovering from anchor damage:

- Can take decades.
- Depends on the extent of the damage and other environmental factors.

The fastest growing branching corals can grow at rates of up to 10cm (4in) in a year, although some species take years to grow just a few millimeters.



Can a reef recover from anchor damage?

While it is possible for coral reefs to recover from anchor damage, this is very slow process that can take many decades. In areas of intense anchor damage, it is unlikely that the reef will ever make a full recovery. In some cases, the reef and the associated life may be lost forever.

Reef recovery means that live coral destroyed by anchoring is replaced by new coral. For new corals to grow, certain conditions need to exist. In addition to the basic environmental requirements for corals to survive (see table below), they need clean, stable substrate. If there is excessive algal growth or sediment in the water, it will be difficult for coral larva to find a surface suitable for them to attach and grow.

Even under ideal conditions, extensive anchor damage can change the composition of the reef. Slower growing corals, if destroyed, may be replaced by the faster growing ones.

What do corals need to survive?

- **Sunlight.** Corals need to grow in shallow water where sunlight can reach them. Since corals depend on the zooxanthellae (algae) that grow inside of them and this algae needs sunlight to survive, corals too need sunlight to survive.
- **Clear Water.** Corals need clear water to survive and don't thrive well when the water is opaque. Sediment and plankton can cloud the water which decreases the amount of sunlight that reaches the zooxanthellae.
- **Temperature.** Reef building corals require warm water conditions to survive. Different corals living in different regions can withstand different temperature fluctuations. However, corals generally live in water temperatures ranging from 20 to 32 degrees Celsius (68 to 90 degrees Fahrenheit).
- **Clean Water.** Corals are sensitive to pollution and sediments. Sediments can settle on coral, blocking out sunlight and smothering coral polyps. Pollution from sewage and fertilizers increases nutrient levels in the water, harming corals. When there are too many nutrients in the water, the ecological balance of the coral community is altered.
- **Saltwater.** Corals need saltwater to survive and require a certain balance in the ratio of salt to water. This is why corals don't live in areas where rivers drain fresh water into the ocean.

What declining reef health means to local businesses and communities

The costs of anchor damage to local communities include:

- Loss of tourism.
- Higher unemployment.
- Lower fish catch.

When coral reefs are damaged or destroyed the impact on local businesses and the local community can be devastating. If 1,000 dive operators in the Caribbean take two boat trips a day and drop anchor on a coral reef, together they will kill or damage up to 4,000 square meters of coral reef every day! This amounts to a loss of millions of dollars from reduced tourism, damaged fisheries, and the loss of coastal protection from storms.

Some of the impacts of coral reef damage include:

- **Loss of tourism revenue.** Revenues from marine tourism will fall in and around coral reef destinations as the colorful corals and diversity of fish decline. The most heavily damaged areas may receive no tourists at all.
- **Higher unemployment.** Fewer tourists can also lead to more unemployment as jobs in hotels, restaurants and shops are lost.
- **Lower fish catch.** Local fishers are also likely to suffer where there is reef damage that leads to a decline in stocks.

According to the World Tourism Organization, tourism is the fourth largest growing industry in the world, bringing in \$462 billion dollars, worldwide. (2001)

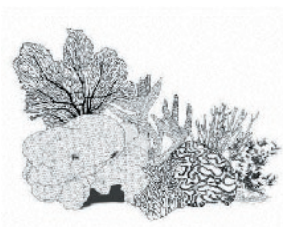


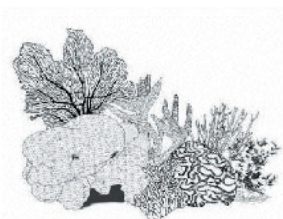
Photo by Burt Jones & Maurine Shimlock

Mooring buoys benefit both businesses and the environment.

Mooring buoys:

- Stop anchor damage.
- Are easy and practical.
- Create visual markers.
- Control diver traffic.
- Enhance safety.
- Enhance convenience.

As divers are becoming more ecologically aware, they are more likely to ask a dive operation if they use mooring buoys. (R.B. Toth Associates survey, 2003)



Benefits of moorings

There are lots of good reasons to install and maintain moorings. Protecting coral reefs from anchor damage is just one.

Mooring Buoys:

- **Stop anchor damage.** Moorings prevent anchor damage to coral reefs.
- **Are easy and practical.** After an initial investment, moorings are easy to install and maintain.
- **Create visual markers.** Moorings are visual markers for divers and boaters which make it easier to navigate to popular sites. Moorings can also help boaters access a greater number of sites, by making lesser known locations easier to find.
- **Control diver traffic.** By limiting the number of boats that can use a buoy and by encouraging the use of a greater diversity of sites, moorings can also help prevent dive sites from becoming overcrowded. This not only helps reduce accidental diver damage, but also makes for a more pleasant experience for dive customers.
- **Enhance Safety.** Moorings decrease the risk of accidents with divers due to irresponsible anchor dropping or unpredictable boat traffic.
- **Enhance Convenience.** Moorings are easy to use. It's generally quicker to tie up to a mooring than it is to drop and pull up anchor, particularly if the anchor cannot be dislodged easily.

Benefits of Moorings	Benefits the Reef	Benefits Dive/ Snorkel Business
Stops anchor damage	✓	✓
Easy and Practical		✓
Mark dive sites	✓	✓
Control diver traffic	✓	✓
Enhance safety		✓
Enhance convenience		✓

Other management options

If moorings cannot be installed, consider:

- Remaining under power.
- Doing drift dives.
- Hand placing anchors.
- Designating no anchoring zones.

If it is not possible to install moorings, there are other ways to help limit anchor damage:

- **Encourage drift diving.** Boats should remain under power instead of anchoring when possible.
- **On smaller vessels, divers can hand place and remove anchors** from the dive site. This will ensure any dragging is prevented.
- **"No anchoring zones"** should be designated locally and on navigation charts. Rangers can be used to patrol allocated zones to ensure that anchor damage is being avoided. Fines or penalties can be given to anyone found to be damaging the reef with an anchor.
- **Boats should only anchor in sand when there is enough space** to ensure that chains do not drag on any part of a reef.

Anchors that are dropped in sandy areas near reefs can still do damage with their chains or if they become dislodged.



Photo by Burt Jones & Maurine Shimlock

Part II: Planning a successful mooring program

Introduction

Mooring Buoy Planning Guide & Checklist

Stakeholder involvement

- Ways to involve stakeholders
- Case Study: Installing & maintaining moorings in Jamaica

Navigating bureaucracy

- Limiting your liability
- User and private mooring permits
- Why have rules?

Mooring site selection

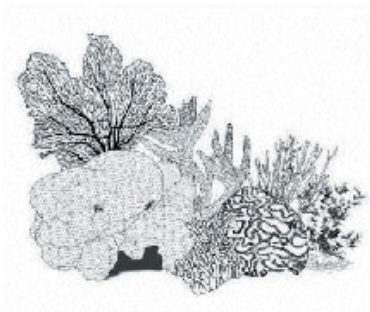
Mooring buoy parts & options

- Mooring Anchors: Different types
- Which anchor to choose?
- Downline : The connection to the surface
- Buoys
- Surface lines
- Other, cheaper options

Maintenance: Taking care of your moorings

Funding installation costs

- Calculating costs
- Creating a funding plan
- Keeping costs down
- Funding sources



Planning a successful mooring program

This section will cover a few of things you will need to think about in order to have a successful mooring program. It may be tempting to install moorings as quickly as possible but in the long-run, your investment in time and money will be better served if you take care of a few important details:

- **Involving stakeholders.** You'll want to think about who else has an interest in mooring buoys and the areas where you would like to install them. Unless you are working in a privately owned area, by including other people in the planning process, you will be building important relationships that may help prevent problems later.
- **Legal issues.** Make sure you have the proper permits to protecting yourself from being sued.
- **Mapping out and designing moorings.** Getting moorings in the locations where they are needed and figuring out what type of moorings you want to use.
- **Enforcement & Rules.** A few good rules will help prevent conflicts between user groups and will help ensure the moorings are used properly.
- **Planning for maintenance.** Developing a maintenance plan early in the game will help ensure the long-term success of the program.
- **Funding.** You'll need a source of funds to cover installation costs AND funds for maintaining buoys when they need to be replaced.

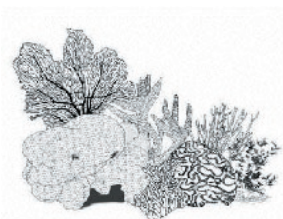


Photo by Burt Jones & Maurine Shimlock

Planning Guide & Checklist

Step I: Planning

1. Involve stakeholders:

- Determine interested parties.
- Community relations & input.
- Delegate the following steps.

2. Investigate and address legal concerns:

- Permits.
- Liability.
- Enforcement or protected area legislation.

3. Design the mooring system:

- Needs assessment.
- Site selection / mapping out your moorings.

- Determine mooring design:
 - Anchors (use your best guess).
 - Downlines.
 - Buoy.
 - Surface lines.

4. Plan administration after installation:

- Rules, proper use & enforcement.
- Maintenance (details see Part IV).

5. Develop a funding plan & calendar for:

- Installation.
- Maintenance.

Step II: Installation

1. Plan:

- Assess need for technical assistance & training. (If using technical assistance, assess remaining steps, and follow advice.)
- Mark specific buoy sites.
- Adjust types of moorings based on research.
- Obtain materials & equipment:
 - Develop materials and equipment list.
 - Find suppliers.
 - Customs assistance & duty waivers.
- Determine logistics for receiving & storing materials/equipment:

- Recruit volunteers for installation: Diving, boat support, public relations.
- Plan a calendar for installation.

2. Install:

- Do as much as possible in advance. (Take measurements and pre-splice rope.)
- Ensure safety.
- Keep good records (Depths, GPS & reference sites).
- Take photographs.
- Send press release.
- Celebrate!

Step III: Implement Maintenance & Education

1. Implement the regular maintenance & monitoring.

2. Implement ongoing education program.

3. Implement ongoing financial support system.

Adapted from the Project AWARE Mooring Buoy Planning Guide. [Http://www.projectaware.org](http://www.projectaware.org)

Stakeholder involvement

Involving stakeholders is critical to the success of a mooring program.

Some of the key stakeholders include:

- Dive operators and marine tour businesses.
- Fishers.
- Universities and scientists.
- Government departments.
- NGOs.
- Other tourist businesses.

Stakeholder's can be involved at any stage of developing a mooring program, including planning, fundraising, installation, and maintenance.

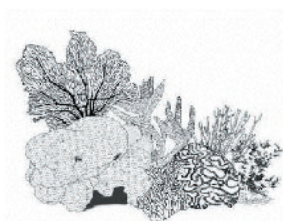
You will want to identify your stakeholders early in the planning phase of your mooring program. Stakeholders might include: local community, fishermen, dive operators, watersport operators, water taxis, government and government departments (such as Harbor Office, Fisheries Dept. etc.), local NGOs, local dive groups, universities and others. Each stakeholder group will have invaluable information and help to offer. Stakeholders who see themselves as part of the mooring planning process may be more willing to use the moorings properly.

Dive Operators and other marine tour businesses. Dive operators have a lot of knowledge and resources to offer a mooring program. They will have an interest in protecting the reef resources their business depends upon, where the buoys are located and how this may impact their business. They may be able to offer help with:

- Providing experienced divers to help with installation.
- Determining where buoys are needed and specific locations where they can be installed.
- Building community support by talking to other dive operators, media, government officials.
- Providing underwater photography of anchor damage (to show the need for buoys) and of installation.
- Donating boats & boat support.
- Donating and raising funds.
- Helping monitor and maintain buoys once they are installed.
- Ensuring that their staff use the moorings properly.

Fishers. Fishers will also have a strong interest in where buoys go and how that will effect their ability to anchor in certain areas. If the installation of buoys is interpreted as a move towards restricting access, there may resistance to the program. It is therefore particularly important to involve them in planning. They may be able to help with:

- Donating and raise funds.
- Helping determine where buoys are needed.
- Building community support through talking to other fishers, media, and government officials.
- Donating boats & boat support, including splicing rope.
- Educating other fishers about the proper use of buoys.



Stakeholder involvement (continued)

Universities. Environmental and resource programs may have:

- Existing studies on the health of the reef that can help build a case for the need for moorings.
- Interest in doing new research.
- Knowledgeable divers and/or underwater photographers.
- Boat access.
- Contacts with government agencies.
- Credible spokespeople who can speak to the press or government.

Government Departments. There are a number of departments that may have an interest in the program, including the Fisheries, Environment, Harbor, Hydrographic, and Parks Departments and even the Navy. These departments can help with:

- Permits for installation.
- Enforcement of rules and patrolling.
- Making changes on official navigation charts.
- Funding.
- Publicity.
- Maps, research and other information.
- Publication of educational materials.
- Maintenance.
- Waivers of customs fees on imported equipment and materials.

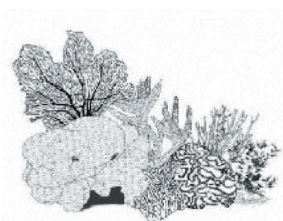
Government. Elected officials may be able to help with:

- Legislative changes for enforcement.
- Funding.

NGOs. Conservation organizations may be able to help with:

- Technical expertise.
- Funding.
- Equipment.
- Providing a method for receiving tax-deductible donations as a fiscal sponsor if you are not a U.S.-based non-profit.

Hydrographic Departments will want to know if any changes are made regarding rules of anchoring.



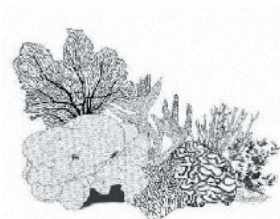
Ways to involve stakeholders

Involving stakeholders will invest the various sectors in the community in the success of the program.

Ways to reach out and involve stakeholders:

- Collect information.
- Recruit leadership.
- Reach out to the media.
- Educate public officials.
- Create information packets or posters.
- Hold or attend community meetings.

Keep the funding and decision-making process transparent. Be as open as possible about how funds are spent. If there is likely to be distrust in the community, be proactive about getting this information to community leaders.



When building coalitions and partnerships look for an approach that integrates the interests of all parties involved. In other words, make the effort to communicate with all potential players and provide a method of involvement which makes each group feel they are active participants.

With interested parties in so many different sectors, you will want to create a bridge between government, industry and conservation organizations. The cooperation that is developed through your mooring project can become a foundation for working together on other conservation projects.

Some ways to reach out and involve stakeholders:

- Collect information - distribute needs surveys, or ask for advice and opinions.
- Recruit leadership - find leaders among different stakeholders who are willing to reach out to their peers and to take up responsibility for portions of the project.
- Get media attention (sending out press releases, talk to your local media).
- Educate public officials. Involve others in contacting decision makers and letting them know about the importance of the project.
- Create information packets or posters. Deliver them directly to stakeholders or displayed in a public location.
- Hold and attend public meetings and workshops, organized by you and other groups.



Mooring installations can be used to educate the general community about reef conservation. Here, an official from the Thai Royal Forestry Department takes time out from a mooring installation to talk to a group

Case Study: Building Community Support for the Installation and Maintenance of Reef Mooring Buoys in Jamaica

In 1991, the Negril Coral Reef Preservation Society began working with Reef Relief, a U.S.- based NGO, to bring together the local community to support the installation of 40 mooring buoys. Not only was the project successful at installing moorings, but it was also an opportunity to educate and involve the community in the larger issues of coral reef conservation.

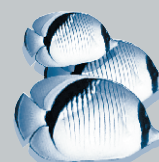
A community workshop, entitled "Protecting Jamaica's Coral Reefs: Reef Mooring Buoy Workshop," was planned to coincide with the installation. Workshop participants experienced the actual installation process (visible through a glass bottom boat) as well as sessions by scientists and government officials on the importance of coral reefs to Jamaica, the current status the connection between healthy tourism and a healthy environment, and other activities working to save coral reefs.

A splicing party on the beach at Negril provided lessons on how the buoy lines are spliced and prepared prior to hooking them up at the reef. The workshop ended with a celebration as the first reef mooring buoys were hooked up at Negril's coral reef.

The workshop also provided an opportunity to publicly thank the many contributors to the project: members of government departments who helped getting duty waivers and installation permits, local businesses who donated funds, accommodation for the Reef Relief team, boats and volunteers; and Reef Relief for loaning equipment, installing buoys and holding a fundraising concert.

The mooring program has been a springboard for other conservation efforts. Additional projects have included the installation of a mooring buoy system for swim lanes on public beaches, reef moorings (estimated to have prevented over 50,000 anchors dropping on coral reefs) and most recently the installation of buoys to mark fish sanctuaries. The project in Negril, Jamaica is a clear example of how mooring buoys can bring diverse interests in a local community together with the primary goal of protecting coral reef ecosystems.

Source: Final Report Of The Negril Reef Mooring Buoy Workshop & Installation Project

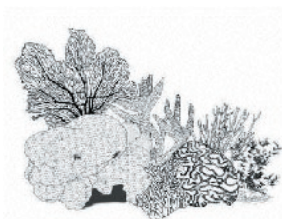


Navigating bureaucracy

Legal issues vary from location to location, but you'll want to look into:

- Installation permits.
- Notifying appropriate government agencies.
- Liability.
- Management & enforcement authority.
- Legal costs.

If you change where it is legal to anchor, you will need to notify the agency responsible for producing the nautical charts for your area, usually the Hydrographic Department.



Before you install moorings you will want to consider some of the official, legal aspects of your project. The steps you need to take will vary depending on local laws and customs and whether you are installing public or private moorings. This may seem overwhelming at first, but with the assistance of a pro bono attorney or an ally in a government office, navigating the bureaucracy can be done!

Some of the questions you will want to consider:

• **Installation Permits & Government Notification:**

- Who has authority over the seabed/water where the moorings will be placed (e.g. Government, MPA, villagers)?
- What permits will be needed to place moorings and run them?
- What other departments would need notification (e.g. the Hydrographic department responsible for creating nautical charts)?

• **Liability**

- Who will be legally responsible for the moorings?

• **Management & Enforcement Authority**

- Who will manage the moorings?
- Will you be able to charge for use of the moorings?
- Will you be able to set rules and regulations for the use of the moorings (e.g. determine who can use the moorings and how)?
- Who will have law enforcement authority over the moorings and how this will happen (is this the same as above)?

• **Legal costs**

- What legal costs will be involved?

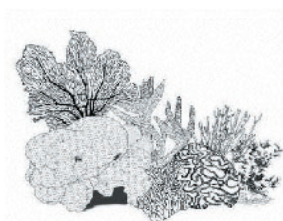
With this information, you can determine what official steps need to be taken to change existing legislation and how long these are likely to take. If this is necessary, support from the other stakeholders can be important in expediting this process.

Limiting your liability

There are a number of ways you can limit your legal liability:

- Evaluate whether to have moorings be required.
- Take steps to prevent accidents.
- Issue rules that enhance safety.
- Provide appropriate warnings.
- Publish a disclaimer.

Mooring sites in areas where currents are strong and/or the moorings are close to shore, may be at a higher risk for causing boat groundings. Some mooring managers have installed redundant lines to prevent accidents in case one line breaks.



If you are the management body and legally responsible for the moorings, there are many ways you can limit your liability should there be an accident.

- **Obligatory moorings.** Be aware, if you make it compulsory for people to use your moorings, your legal liability may increase considerably.
- **Accident prevention.** Safety first! The best way to limit liability is to make the moorings are as safe as you can:
 - Establish & use a schedule for mooring maintenance.
 - Keep a written log of all mooring maintenance and when it is performed. Generally speaking if you always keep a log this becomes a legal document which can be used in court. You should also be able to show that you have an excellent track record of performing mooring maintenance as soon as problems are reported.
 - Consider taking special care at "high risk" sites (i.e. sites where boats might run aground) such as putting out redundant lines.
- **Rules & Warnings.** It is very important to make sure that everyone using the moorings knows that they are obliged to follow the safety rules (See "Why have rules?"). Boaters should be sure to:
 - Tie their boat on safely.
 - Leave someone on board at all times.
 - Check all mooring lines before leaving the boat.
- **Disclaimer.** It is also a good idea to have a printed disclaimer which appears in any information (leaflets, brochures, etc.) about the moorings. It can be very simple such as:

"Be advised that cannot accept liability for any loss or damage incurred while using moorings. Use the moorings entirely at your own risk."

Issuing Permits:
In order to issue permits for moorings you will need to establish a process for doing so.

User and private mooring permits

There may be instances when you may chose to issue permits, either for the use of public moorings or for a mooring for the exclusive use of a private owner. If you do need to issue permits, you will need legal advice about:

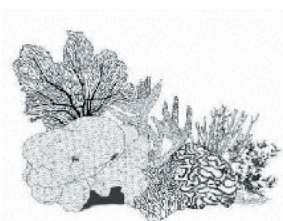
- The process you will need to follow.
- The costs involved.
- How long it will take to issue each permit.
- How you should set up the permit.

There may well be templates you can copy. Generally speaking you will need to be very clear about who the permit is issued to, what costs are involved and when they need to be paid and it how long the permit is valid for.

Permit fees for using moorings can help finance a local marine park or mooring program.



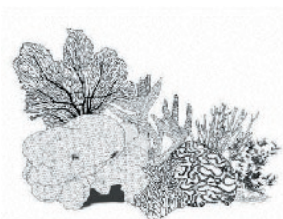
Photo by Burt Jones & Maurine Shimlock



Rules for mooring buoys will help:

- Limit liability.
- Protect moorings and cut down on maintenance.
- Avoid conflicts between users.

Having rules that are well-publicized can significantly cut down on the need to replace buoys broken from misuse.



Why have rules?

Rules will help limit your liability, and they will also make other aspects of a mooring program easier. You will probably want to have some rules about who uses moorings and how they are used in order to:

- Ensure that boats and passengers are safe.
- Protect the moorings and the reefs.
- Avoid conflicts over mooring use.

Safety First!

Legally, it is important to cover your liability in case of an accident. Mooring users need to know that they must:

- Tie their boat off securely.
- Check all the mooring lines at the start of the dive.
- Have someone on the boat at all times.
- Know when it is unsafe to use moorings, such as during particular weather conditions.

Protecting the Moorings and the Reef

You will want to make sure mooring users:

- Put out their own line (known as a scope line) which is at least as long as their boat to make sure moorings are not dragged or over stressed.
- Do not overload the mooring buoy, especially in rough weather.
- Tie on by the bow to reduce drag on moorings.

Sharing Moorings Among Different Users

If you have different groups using the moorings (such as fishermen, dive operators, water taxis, and snorkel tour operators) you will want to listen to the users to avoid over crowding and over use of moorings and to minimize conflicts over use (especially with fishermen). You may want to think about:

- Sharing space (get different users to use different moorings).
- Sharing time (get different users to use moorings at different times of the day).
- Sharing access (put limits on the amount of time users can stay on a mooring).

Why have rules? (continued)

Sharing Moorings Among Dive Operators

Dive operators are likely to want access to the same moorings at the same time of the day. Here, you may want to consider:

- Having an informal or formal booking system for moorings.
- Allocating the most popular moorings to dive operators on a rotating basis.
- Adopting a “first come first served” rule.
- Limiting the amount of time users can stay on a mooring (for example: 2 hours).
- Staggering the times that individual dive operators use the same moorings.
- Avoiding the creation of a “hit list” which can create too much demand on a very few moorings.

How to Enforce Rules

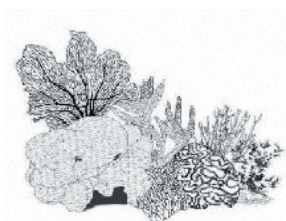
When things do go wrong you will need to know who has law enforcement authority and how the system works.

- Write up and issue a prosecution.
- Charge fines.
- You will also need to be able to value your reefs, so that you can make claims for any damages.

Ways to enforce mooring use and rules include:

- Patrol boats.
- Fines.
- Volunteer reporting.

Rules that help avoid conflicts among users can also help to reduce the amount of diver traffic, which benefits both reefs and divers.



Mooring site selection

If mooring buoys are used correctly and well maintained you can expect them to last for a long, long time, so it is worth spending a little time selecting the right sites before you begin. Sometimes the locations for your new moorings will identify themselves ... but not always.

Where should they go?

The idea of installing moorings is to protect your reefs from anchor damage, so you won't want to place them in areas where no-one will use them. Installing your moorings in the middle of your most attractive reefs is also not a great idea because you can expect to see some loss of coral close to the mooring even if your divers are well educated and dive carefully.

Planning Considerations

Where you choose **not** to place moorings can be an important decision too. Moorings can be used to protect sensitive areas and create closed areas, to control access and to reduce user conflicts. While you are creating your ideal mooring system there are some planning and policy considerations to take into account. You should think about whether:

- You want to concentrate moorings in one area (creating a honey pot effect) or spread them out as much as possible.
- You want to have closed areas (to protect critical habitats or to create control areas) with "buffer zones" around them.
- There is any existing or planned zoning you need to take into account.

Also ...

- Think about tomorrow. Dive boats tend to get larger over time as the local dive industry establishes itself. You will want to try to be able to accommodate growth.
- Avoid placing moorings in shipping lanes or anywhere they might constitute a "hazard to navigation" such as near the entrance to a harbour or marina.

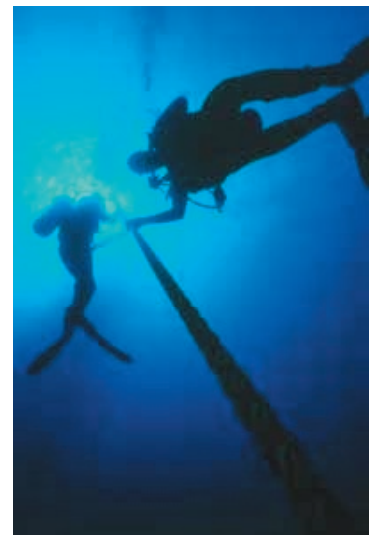
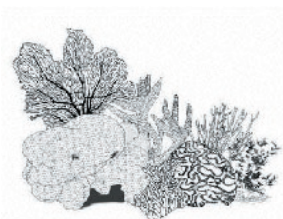


Photo by: Dave Read

www.daveread.com

Moorings will concentrate diver use in one particular area, so keep in mind that there may be more diver damage in the immediate area around the buoy.



Mooring site selection (continued)

- If you are aiming to create a system of public moorings avoid siting moorings so that it looks like you are creating “personal” moorings for individuals or businesses.
- If in doubt choose the selection criteria you believe are the most important and develop a matrix to compare the different possible sites for moorings.

You will also want to think about the specifics of each site:

- Where exactly you place your moorings may depend on the substrate (sand, rubble, bedrock). If you are planning to put in drilled pin (Halas) moorings you will have to place them where you can find firm bedrock.
- Ideally you will want to place moorings on bare bedrock (pavement), in sand or on coral rubble near but not on the reef to minimize damage to the reef through installation and use.

Safety First

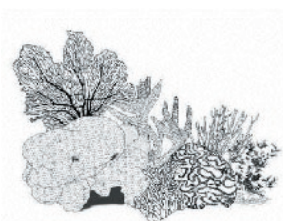
Make sure moorings are:

- Far enough from land and the reef so that boats cannot run aground.
- Safe for boats to use under most weather conditions and sea states, remembering there should be someone on the boat at all times.
- Deep enough at all states of the tide.
- Shallow enough for installation to be done safely. Placing drilled moorings in deep water can be costly and dangerous. An ideal depth is somewhere between 20-40 feet.

Case Study: Selecting Sites for Moorings

“In September 1991, divers from the Negril Coral Reef Preservation Society and Reef Relief spent five days logging fifteen dives inspecting bottom conditions and depths to select mooring buoy sites for the reefs of Negril, Jamaica. All of the sites are used on a daily basis by the commercial dive/snorkel industry as well as by fishermen and were subjected to daily anchor damage. The results of the inspection dive gave us the necessary information to draw up a list of components required for the installation process. We made a determination of what type of anchor system to use at each location, ordered the components, and developed a chart of the potential installation sites which expedited the permitting process. The Negril Coral Reef Preservation Society then received permits to install forty reef mooring buoys.”

From: Final Report Of The Negril Reef Mooring Buoy Workshop & Installation Project



Mooring site selection (continued)

Spacing Between Moorings

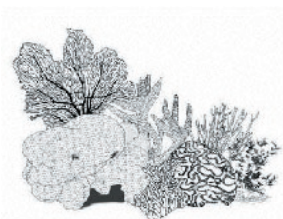
- To create a “buffer zone” between moorings then you will need a minimum spacing of 400–600 feet (120-200m) - so that most divers cannot swim to an adjacent site and back again in one dive.
- To crowd as many moorings at a site as possible—depending on boat length, sea state etc.— you will probably need at least 150—200 feet (45-60m) between moorings.

Protecting the Reef

- You can expect to see significant changes to the reef, mainly the loss of coral—within 50-100 feet (15-30m) of the mooring at most reef sites where a mooring is set up.
- Beyond 200 feet (60m) you should not be able to detect any changes to the reef IF your divers are well educated and dive carefully.

Scouting & Relocating the Mooring Position

- Once you have decided exactly where you want your mooring to go it's a good idea to buoy it just before you plan to do your mooring installation.
- If you can take a GPS fix, find two or more suitable transect lines (fixed objects such as trees and buildings which are in line) or take compass fixes.



Mooring buoy parts & options

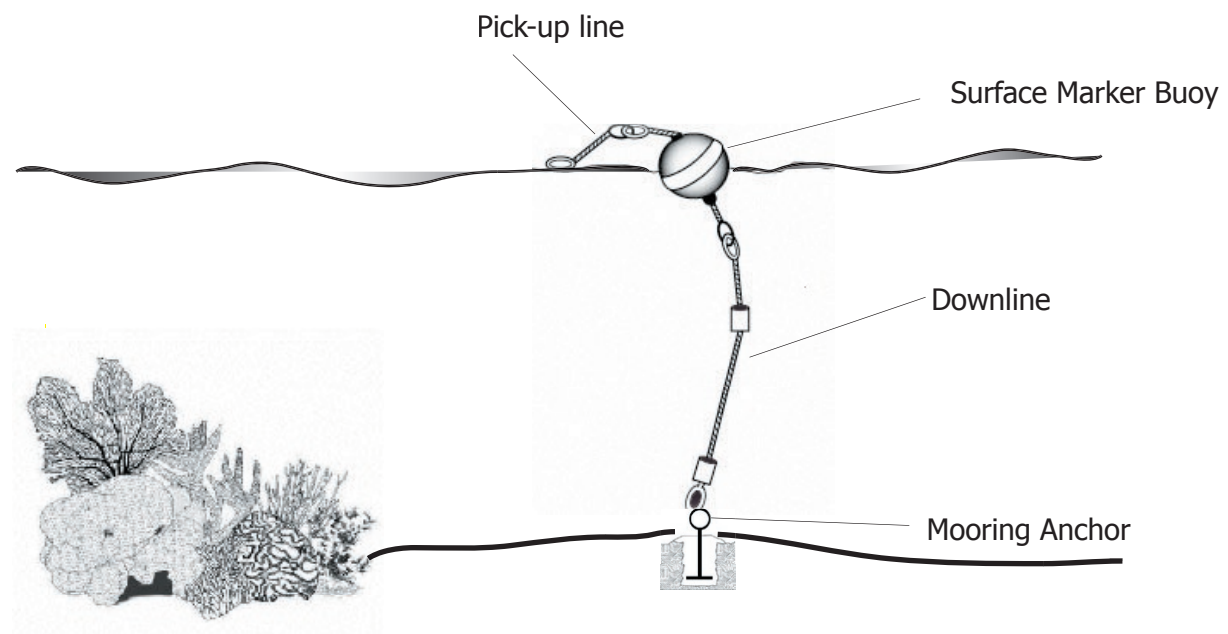
Mooring buoys are made up of:

- Mooring anchor.
- Downline.
- Surface buoy.
- Pick up line or surface line.

Mooring buoys are made up of four basic parts:

- **Mooring anchor.** An object that is permanently attached to the sea floor – it could be a heavy weight or a device that is embedded in the sea floor.
- **Downline.** A line that leads down from the surface and connects the anchor to the buoy. This can be made of rope or chain (also known as a rode).
- **Surface marker buoy.** A float that rests at the surface, and holds the weight of the downline and is easily visible to boats.
- **Pick-up line or surface line.** The line that connects the boat to the buoy. Boats “pick up” this line out of the water to tie up to the buoy.

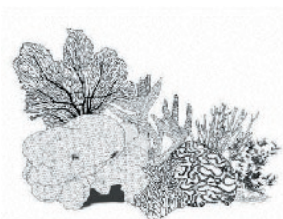
There are a number of different options for each of the four different parts of a mooring buoy. Not all types of mooring buoys are suitable for coral reef areas. Look at the specific conditions of your area and determine which systems will work best. Then look at the practical side: ease of installation, cost, durability and availability of replacement parts.



The three basic types of moorings are:

- Drilled moorings.
- Embedment anchors.
- Weighted anchors.

Not all mooring buoys are appropriate for coral reefs. Choose your mooring system carefully.



Mooring Anchors: Different types

There are two basic types of mooring anchors:

Embedment anchors: Embedment anchors are embedded in the sea floor. Embedment anchors require special equipment to install but with a little training, an experienced diver can learn to how to put these in.

Embedment anchors can be either:

- **Drilled moorings**, where a hole is drilled into hard bedrock and a pin is cemented into place. The strength of the anchor largely depends on the strength of the substrate (i.e. an anchor in coral will not be as strong as volcanic rock).
- **Metal embedment anchors** are specially designed to be embedded in soft substrates and held in place by the weight of the sand or rubble. Manta Ray anchors and Helix anchors are the most commonly used types. The strength of these anchors depends on their size and how deeply they are installed.

Weighted anchors: Weighted anchors are also known as traditional or conventional or concrete moorings. The anchor is a heavy object that rests on the sea floor. This could be a cement block or a heavy piece of scrap metal. Its strength depends on its weight underwater and may not be suitable for coral reef areas because weighted anchors can drag and damage large areas of coral.



Photo: © Green Reef in Belize.

Weighted anchor system.

In deciding which anchors will work best, you will need to consider:

- Substrate.
- Holding capacity needs.
- Cost of maintenance.

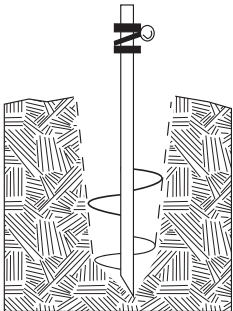
Which anchor to choose?

Choosing the right anchor is the most important part of your mooring buoy design. You will need to consider what types of anchors are suitable for your mooring sites, how much holding capacity you will need and practical matters such as cost and availability of equipment and replacement parts.

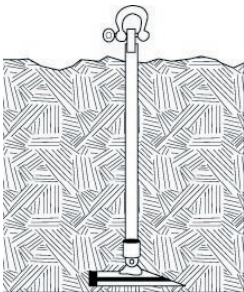
1. Consider your substrate type and depth. An expert can quickly help you determine the type of substrate you have. Sand or rubble may be hiding a layer of bedrock which would make the installation of helix or manta ray’s difficult (or impossible). It can be tricky to determine how strong the substrate is or how deep you will be able to embed an anchor. You can save a lot of time and money by working with someone who has experience installing mooring anchors, such as another marine park, NGO, or the company selling the mooring equipment.

Substrate	Mooring Type
Sand and/or Rubble	Manta Ray, Helix
Hard Substrate (solid bedrock, hard limestone or lava)	Drilled moorings
Semi-hard substrate (softer fossil-ized coral).	Helix or drilled mooring.

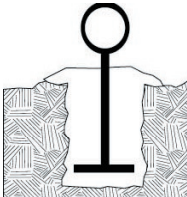
If the mooring location is not close to a sensitive habitat, like a coral reef or seagrass bed, you can also consider weighted anchors for all substrates.



Helix



Manta Ray



Drilled



© Wolcott Henry 2001

Weighted Anchor

Which anchor to choose? (continued)

2. Consider holding capacity,

There is no precise way to determine how much a mooring anchor will be able to hold. The strength of the anchor will depend on the installation, the substrate and the size of the anchor, as well as environmental conditions such as weather and currents.

By considering the size of the boats that will be using the moorings (keeping in mind that boats will likely get larger over time), it will be easier to guess which anchors will hold.

- To calculate holding capacity, use an estimate of 65ft sailboat = 30,000 lbs.
- Consider that areas which are frequently used or are frequently exposed to rough weather will benefit from stronger anchors.
- To increase holding capacity of an anchor you can use a larger anchor or use multiple anchors chained together. These also help to act as a back up system in the event that one anchor fails.

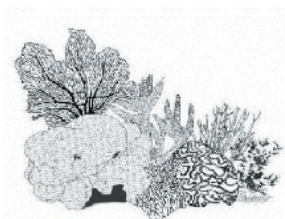
3. Consider the costs and ease of maintenance.

You'll want to look at the entire cost of the anchor including replacement costs. Using parts that are available locally is highly desirable. See the fundraising section for a list of different parts to consider.



Photo by L. Dee Scarr

To install embedment anchors you will be using specialized equipment. If you are able to raise money to purchase this equipment and to train staff, you will be able to maintain the moorings more easily.



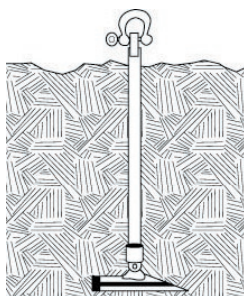
Mooring Anchor Selection Chart

Substrate	Low Holding Capacity	Average Loads	Extra Heavy Loads
Soft Substrate <ul style="list-style-type: none"> • Sand • Clay • Mud 	<ul style="list-style-type: none"> • Weighted (Block Mooring)* 	<ul style="list-style-type: none"> • Manta Ray • Helix 	<ul style="list-style-type: none"> • Multiple Mantas • Multiple Helixes
Semi-hard Substrate <ul style="list-style-type: none"> • Softer coral • Hard pan 	<ul style="list-style-type: none"> • Weighted (Block Mooring)* 	<ul style="list-style-type: none"> • Manta Ray • Helix • Drilled 	<ul style="list-style-type: none"> • Multiple Mantas • Multiple Helixes • Multiple Drilled
Hard Substrate <ul style="list-style-type: none"> * Bedrock • Older fossilized coral 	<ul style="list-style-type: none"> • Weighted (Block Mooring)* 	<ul style="list-style-type: none"> • Drilled 	<ul style="list-style-type: none"> • Multiple Drilled

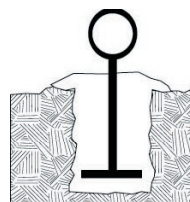
*Not recommended for near reef or seagrass environments.



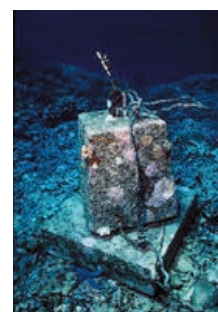
Helix



Manta Ray



Drilled



© Wolcott Henry 2001

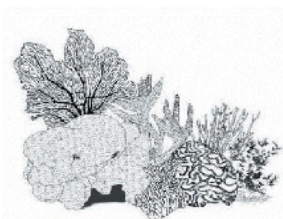
Weighted Anchor

THIS INFORMATION IS FOR GUIDANCE ONLY. PLEASE BE SURE TO CONSULT SOMEONE WITH EXPERIENCE INSTALLING EMBEDMENT ANCHORS TO DETERMINE THE CORRECT MOORINGS FOR YOUR AREA.

Downlines need to be:

- Strong.
- Flexible.
- Easy to maintain.
- Proper length.

Some mooring systems add a lead weight to the downline to keep excess rope from floating to the surface.



Downlines: The connection to the surface

Two of the most important qualities of a good downline are the right length and the right material. In picking your downline, you will want to look for a combination of strength, flexibility and ease of maintenance.

Some of the more common types of downlines are:

Rope. Rope is usually the preferred material of a downline. Its natural flexibility makes it quite strong. It is readily available, lightweight and easy to work with. Three pieces of rope with loops spliced on both ends can be interlocked to create a buoy tackle that is easily assembled and disassembled. Sometimes a small weight will be used on the downline to keep excess rope from floating on the surface and catching on boat propellers. The rope thickness will depend on the holding capacity needed. A plastic chafing hose may also be used at the connecting points to protect the rope from wear.

Chain. Chain can do significant damage to reef areas, similar to anchor chains. Although metal may seem to be stronger than rope, it is not as elastic, and therefore must be quite substantial to withstand the pull of boats in rough weather. Also, due to its weight chain is harder to install and repair and requires a larger buoy to hold it up. Chain may be used in situations where a buoy is frequently cut.

Special materials. If your budget allows and buoy theft is not a concern, you should consider these materials:

- Hazelett rode; An elastic material specifically designed for moorings. (Costs approximately \$500 a piece)
- U/V Treated rope: This rope is specially treated to protect it from sun damage and may last longer than conventional rope.
- Hawser wire: Wire rope usually made out of galvanized steel.

Length. The length of the downline is a matter of preference. Downlines should be long enough so that in bad weather or when a current is running your surface mooring buoy is not dragged underwater. The line should not be so long that it could wrap around or get snagged on the bottom of the reef. It also may be desirable to keep the line short so the buoy does not get pulled above the surface of the water easily. There are formulas you can use to calculate the ideal length of your lines. But remember, every situation is different and you will soon find the ideal length for each mooring.

Buoys

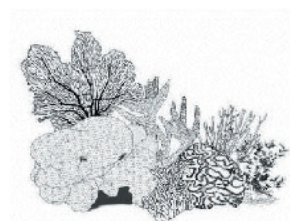
Buoys should be:

- Visible.
- Sufficiently buoyant.
- Durable.

Buoy options include:

- Manufactured buoys.
- PVC pipe buoy.
- Plastic containers.

Buoys are not just surface markers. Their buoyancy helps relieve pressure on the mooring anchor.



The surface buoy has several different purposes and your buoy selection will depend somewhat on the other buoy parts you are using and how you want to use the buoy as a marker. The ideal mooring buoy is:

- **Visible.** A buoy should be easy to spot, clearly marking the mooring for boaters. Bright colors such as orange or white are often used, and reflective tape can be used around the center to make the buoy more visible at night.
- **Buoyant.** While this should be obvious, keep in mind that smaller buoys will be less buoyant. If your downline is entirely or partly chain, a smaller buoy will not be able to support its weight. Also, greater buoyancy means that it will be harder for a rocking boat to submerge the buoy and pull directly on the buoy anchor.
- **Affordable.** If moorings are likely to be stolen or broken, inexpensive and less desirable options are preferable.
- **Durable.** Ideally, your buoy should last a long time.
- **Identifiable.** The buoy can also be used to identify the location with a name and/or number. Different shapes and colors can be used to indicate that the mooring is to be used by water taxis and another for dive boats.
- **Attractive.** This may or may not be important. Some owners of beach property may be concerned about the moorings look on the horizon.

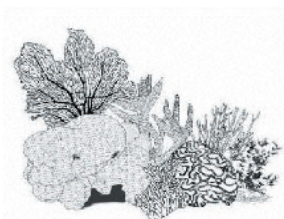
Mooring buoy options include:

- **Manufactured buoys.** There is a wide selection of buoys that can be purchased made of foam or plastic or a combination.
- **PVC Pipe.** An inexpensive buoy can be made from PVC pipe closed on both ends and filled partially with sand. These buoys are a good balance between aesthetic and practical issues. Their relatively small size does mean that they provide less “spring action.” (See Appendix)
- **Plastic containers.** Heavy duty plastic containers, often used for gasoline or freon, often have built-in handles and can be used as make shift moorings. These are less attractive than the other moorings, but may be less likely to be stolen. If they get a hole in them they will sink, unless filled with foam.

Surface lines:

- Require more maintenance than other parts of the buoy.
- Are more susceptible to sun damage.
- Will last longer if they are used with a scope line.

Using a scope line from the boat to attach to the pick up line helps protect the mooring buoy from unnecessary pull.



Surface lines

Surface lines allow the boaters to moor up to the buoy. In some cases they may simply be the part of the downline that extends beyond the buoy. The pick up line is often a thinner rope than the downline and may be a good candidate for U/V treated rope because it will float on the surface where it will be more susceptible to sun damage.

Generally, the part of your mooring system which requires the most maintenance are your surface lines. You can prolong the life of surface lines and encourage good mooring use by:

- Keeping pickup lines short so boaters are forced to put their own line out (scope line) out when tying up.
- Put a length of plastic hose around the pickup line eye slice to cut down on chafing.

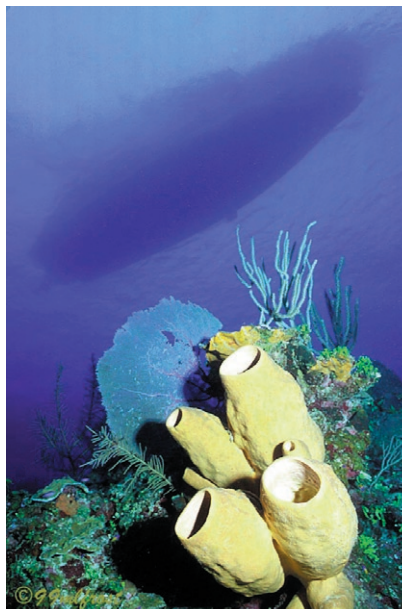
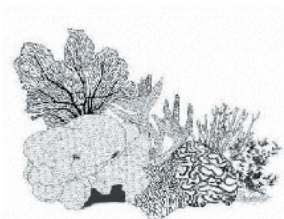


Photo by: Mary Lou Frost

There are other, cheaper options but they may not be suitable for coral reef environments. They include:

- Natural formation anchors.
- Engine blocks.

Using a coral head as a mooring anchor may send mixed signals to divers, who, after seeing a rope or chain wrapped around a coral "bombie" may then assume that its okay to touch the coral. Similarly, dropping an engine block may make it okay to dump other refuse.



Other, cheaper options

If your budget is limited, there are other mooring options, although they may not be suitable for a coral reef environment and the risks should be considered carefully.

Natural anchors or "chokers." Chokers use natural formations, such as rocks or coral heads as a mooring anchor. The downline is looped around and "chokes" the coral. This is an inexpensive option, but there are a number of disadvantages that need to be considered.

Disadvantages:

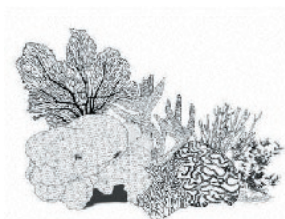
- It can be difficult to find natural formations in the right locations.
- Chokers can also destroy the coral head or encrusting marine life it is attached to. Some coral heads may adapt to the choker, but others may be stressed, bleach or become vulnerable to disease.
- The mooring is also only as strong as its base and predicting the holding capacity of corals is be difficult. Sometimes even large massive corals have developed on a small rock that is not actually connected to the sea bottom. Dead coral formations are subject to boring animals such as clams and worms, and may erode over time. Other coral heads which appear to be solid live coral may in fact be older, dead coral heads that have been covered by encrusting corals. Although the surface is alive and intact, the inner structure could have already been eroded by boring animals. If the wrong coral head is chosen, not only will the mooring be lost, but the entire coral colony could be destroyed.

Engine blocks. Although engine blocks are sometimes used to secure a mooring, they are not suitable for reef moorings.

Maintenance:

- Promotes safety.
- Helps limit liability.
- Improves image of park management.
- Keeps moorings functional.

In the Florida Keys an average of 6 to 15% of all mooring loss is due to boats running over buoys.



Maintenance: Taking care of your moorings

It's important to plan for replacing broken moorings and doing some preventive maintenance. It can be tempting to rush into installing moorings without making an advance plan for maintenance, although there are several good reasons why it is advisable to do so.

- **Safety.** Safety, both for your users and their boats and for the coral reefs they protect, should be your primary consideration when running a system of moorings. No one will use moorings they consider to be unsafe and you must keep your moorings well maintained if you want to limit your legal liability.
- **Moorings are your “calling card.”** If you are running a Marine Park, moorings are probably the most visible part of your Park. In a sense, they are the Park's calling card. A well managed and well maintained system of moorings inspires confidence and everyone can see the Marine Park is doing real conservation work.
- **Nothing is permanent.** Although these are “permanent” moorings, they can break. A few rules and a user education program will help, but will not eliminate the need to replace moorings. Some of the causes of mooring breakage include:
 - Overloading beyond the holding capacity.
 - Improper use—using too little scope line, particularly during rough weather.
 - Accidents—boats running over moorings can puncture the buoy or chop up the pick-up line.
 - Theft and vandalism—moorings may be cut and stolen.
 - Aging—at some point, materials need to be replaced.
- **Don't be discouraged by broken moorings.** Just be prepared to replace them quickly and learn from what went wrong. Having a practical, funded maintenance program in mind before installing your moorings will help ensure the long-term success of the program. For more details, see the Maintenance section.

Funding your project involves raising money for both installation and maintenance.

Costs will vary depending on your local area and the types of moorings you use. To raise the funds you will need to:

- Calculate costs.
- Write a project plan.
- Identify and approach potential funders.

Funding installation costs

Once you have decided which kind of mooring system you want to install and how many moorings you want to place, you will need to think about how you are going to pay for your mooring installation. (Keep in mind that there are two types of funding you will need to think about: installation AND maintenance costs. Maintenance costs and funding are discussed in a later section).

Mooring installation costs are likely to be high and you can expect placing a set of a round 20 drilled moorings to cost anywhere from around \$400.00 per mooring to \$ 1,000.00 per mooring depending on if you have to buy the installation equipment, how remote your site(s) are, how long it will take to install the moorings etc. Installing different kinds of drilled moorings such as pins and helixes requires different kinds of drive head, so if you have to mix moorings expect your costs to go up. Making concrete mooring blocks can be considerably cheaper but concrete blocks, especially very large ones, can be difficult and costly to place on site.

Even if your costs are high for installation, with creativity and persistence it is possible to find donors who are willing to invest in the protection they provide reefs.

To fund your project you will need to:

- Calculate your costs.
- Write a project plan.
- Identify potential funders.

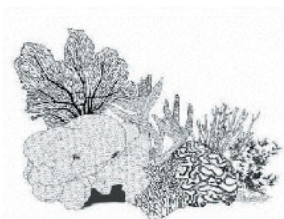


Photo by: © Michael Cowman

Calculating costs

To calculate the costs of installation you will want to include:

- Materials.
- Equipment.
- Technical assistance.
- Transportation.
- Contingency.

You may also want to include some maintenance parts in your initial budget.

The first step is to work out what the likely costs will be. Remember to include all of the following:

Drilled, helix or manta moorings:

- U-pin triad or similar (for drilled moorings), manta moorings or helix moorings.
- Extension rods for helixes (if necessary).
- Shackles.
- Two component epoxy (Drilled only).
- Epoxy injection gun (Drilled only).
- Hydraulic power pack (such as 8 gallon/minute, 2000 psi).
- Appropriate drive head (torque, rotary or core).
- Hydraulic drill and drill bits.
- Hoses (quick disconnect are best).

Concrete moorings:

- Concrete.
- Re-bar (for anchoring points).
- 4" PVC Pipe.

Installation assistance:

- Flight.
- Accommodation.
- Salary or per diem (to cover food and drink).
- Transportation at site.

Tackle:

- Rope (such as U/V treated polypropylene line).
- Shackles.
- Buoys.
- Chafing hose.

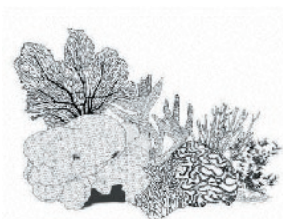
Transportation:

- Shipping.
- Handling.
- Duty (for imports).

Placement:

- Boat rental (including boat captain).
- Staff.

You will probably want to add a "contingency" to your final figure of between 5-15% to cover unforeseen expenses.



Create a plan to present to potential funders.

Creating a funding plan

Once you have worked out what your costs will be it's time to commit your plan to paper. You will find individuals, companies and grant funding agencies much more willing to give you money if you have taken the time to think things through and come up with a plan.

Include in your plan:

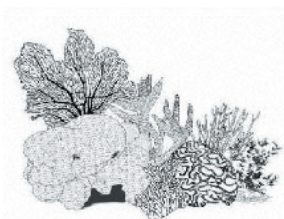
- Background information on the project.
- Why the moorings are needed.
- Why you need the type of mooring you have chosen.
- Where you want to place moorings.
- How you propose to place them.
- When you propose to begin and when the project will be completed.
- Who will use them.
- Cost of mooring installation (budget).

When you write out your budget be sure to include ALL of the costs then make a note of which ones are being covered by grants or donations or "in kind" contributions. That way everyone can see that your mooring installation project has support and that other people and groups have already "bought into" it.

Your mooring installation plan can provide information for any grant funding proposals you might end up writing.



Photo by Jeff Dawson



Keeping costs down

You can keep costs down by:

- Using volunteers.
- Asking for in-kind contributions or discounts.
- Investing in training.

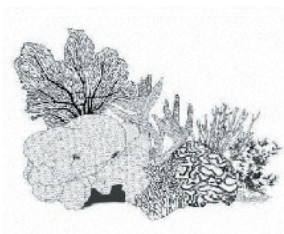
You can keep some costs down by looking for local volunteers to help with mooring installation. Be sure that volunteers are certified divers with an appropriate background and adequate diving experience. Placing moorings is hard work and can be dangerous.

You can also look for "in kind" contributions. Ask local hotels if they will sponsor the project by giving you free or at cost accommodation and means. Ask dive operators if they can "lend" you boats and staff.

Look for any commercial dive operators in your country who can supply you with drilling equipment, hardware and tackle. You will also want to decide whether to purchase or rent equipment if you have the option.

Invest in training. The more expertise in installing the moorings remains with you on site, the better! Next time you may be able to install them with little or no outside assistance.

Purchasing equipment may save you money in the long run. Parks can even rent this equipment out to raise funds.



Funding sources for mooring installations include:

- In kind donations.
- Corporate sponsorships.
- Individual donations.
- Fundraising events.
- Grant funding.

Funding sources

You will need to think about whom you can approach to fund, sponsor or co-fund your mooring installation costs.

In kind donations. These are donations from people or organizations which cost them little or nothing, such as, dive operators who might be asked to lend boats and staff or hotels might be asked for free or “at cost” accommodation. If they support your mooring project you have no problem getting local in kind donations like this.

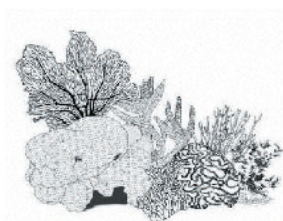
Corporate sponsorship. Make a list of the medium to large size, profitable businesses in your area, which rely on the environment, or which are known to take a philanthropic interest in local affairs. Especially look for businesses with holdings in the USA or Europe where contributing towards environmental projects may already be part of their corporate thinking.

If you know the manager, great! If not try to find someone who can “open doors” for you and introduce you to the person in charge. Take a spare copy of your plan along and be prepared to give a short but lively presentation on your mooring project and what you want to do. The golden rule here is: “If you don’t ask, you don’t get!”

Individual donations. Try to encourage individuals, especially visiting divers, to make a donation towards your mooring project. Depending on your local laws, you may have to do this through a local charitable organization, which would accept donations on your behalf, or you might have to set up your own charity. Make sure that it is worth your time and effort and that the cost of getting donations is not going to be more than the money you collect. Also, make sure you have a fool proof way of taking the money. You will be held accountable for the money and you need to make sure that there is no possibility that it could “go missing.”

If you have wealthy local residents, consider approaching them, too. They are most likely to be sympathetic if they or their family members are divers or snorkellers.

Fundraising events. Holding a local fund raising event can be a good way of raising money. You probably already know the kind of fund raising events which work in your area. What do your schools and churches do to raise money? Think about things like sponsored dives or snorkels, sponsored car wash or holding a festival. Use your imagination! Again, whatever the



Funding sources (continued)

event, you will need to be sure that it is worth your time and effort.

Grant funding. Applying to grant funding organizations, such as foundations, is another possibility. This is something of a “long haul” approach: you will have to make an application and there may be a delay of several months or a year before you finally receive the money – if the project is approved.

Generally speaking funding organizations have their own procedures for accepting applications. You will most likely apply for “small grant funds.” Many of organizations expect you to complete an application form. Often they only make decisions about which projects to fund two to four times a year so you should also find out about any submission deadlines.

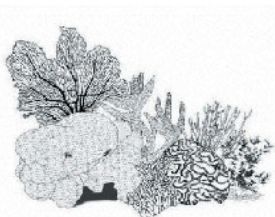
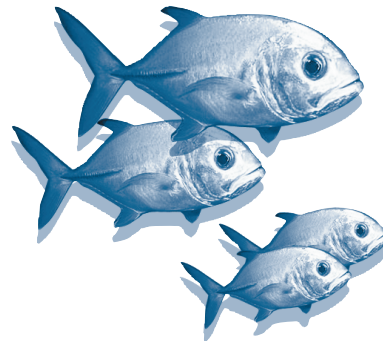
Filling in a funding application can be daunting. Again, it is worth taking the time to find out if they are likely to fund your mooring project before you begin filling in the forms. A search of their web site or a simple phone call to the person in charge of administering the funds should give you a good idea of whether or not to apply.

You should also be aware that funding organizations normally expect you to report back to them and explain how you spent their money and what you achieved. They will often want written reports and accounts with receipts. Be sure to keep all your invoices and receipts and take plenty of photographs of the work in progress as well as the finished mooring in use.

Look at:

- PADI Project AWARE.
- NOAA small grant funds.
- UNEP small grant funds.

When raising money, it is important to keep the process as “transparent” as possible, so community members & funders know exactly where the money is going.



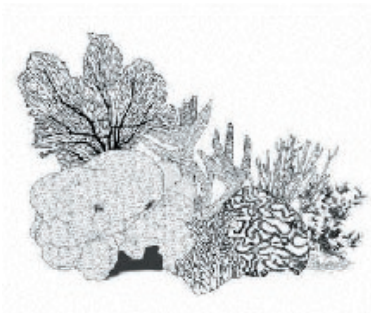
Part III: Installing Moorings

General installation tips

Installation overviews

- Drilled moorings
- Manta Ray Anchors
- Helix Anchors

Preparing the Tackle: Downlines, surface lines and buoys

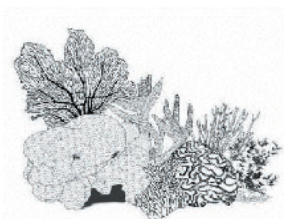


Installing moorings

Once you have finished with your planning, you should be in good shape to begin working on the actual installation of your moorings. By now you have:

- Built the support of your community and necessary entities.
- Secured the proper permits.
- Researched and addressed any legal issues.
- Put together a plan including mapping out where your buoys will go and what types of buoys you will likely be using.
- A plan for what the rules will be for buoy use and how you will enforce these rules.
- A plan for how to maintain the buoys.
- Raised funds to cover the costs of installation.

This section will give some general ideas for planning an installation and look at the different issues involving the various anchor types. This information does not take the place of the assistance of a technical advisor. Each location is different and the support of someone who has experience installing mooring buoys can be critical to determining the proper buoy, and having it installed properly and safely. It is also important to remember that buoys should only be installed by experienced divers.



General installation tips

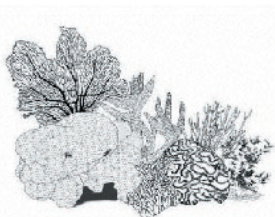
Although every installation is different, here are some of the key steps to remember:

- **Assess need for technical assistance & training.** Technical expertise is critical in helping establish that you are installing the correct anchor (if using a drilled, helix or manta ray).
- **Scout & mark specific buoy sites** using marker buoys, or GPS & reference points so they can be relocated. You should also keep a record of the depths so you can prepare the amount of rope.
- **Adjust types of moorings** based on research at specific sites (i.e. if substrate turns out to be inappropriate).
- **Get materials & equipment**
 - Develop materials and equipment list. (You will need to decide whether to rent or purchase installation equipment).
 - Find suppliers.
 - Customs assistance & duty waivers may be available through the government.
 - Determine logistics of receiving & storing materials/equipment.
- **Recruit volunteers for installation.**
 - Divers - use experienced divers only.
 - Boat support - less experienced divers or non-divers can be support on the boat. It is also useful to have experienced rope splicers on the surface.
 - Public relations- Find photographers for both above and below water and publicize your mooring installation.
- **Schedule** the days for installation, allow sufficient time and be prepared to be interrupted by bad weather.
- **Do as much ahead of time as possible** – cut and splice rope for the downlines in advance based on information from scouting. Splice pick up lines.



Mooring installation organized by Green Reef an NGO in Belize, with microgrant from CORAL.

Don't forget to celebrate when you've finished. Not only to reward yourself and your volunteers but also as an opportunity to build support for maintaining the moorings.

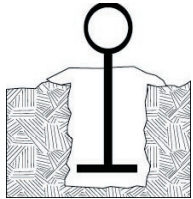


With everything planned, you should be ready to install your moorings. Keep in mind, you'll want to:

- **Ensure safety.** Assign a safety officer to keep track of installers dive profiles. Use experienced divers who understand the risk.
- **Keep good records** of locations and depths.
- **Start with installation in a couple of easy spots on the first day.** Move to the more difficult ones as quickly as possible or when the conditions will be best.

Installation overview: Drilled moorings

The following are brief overviews on what installation of the different anchors requires. Conditions vary from area to area, and this information is not a replacement for professional technical advice.



Drilled Moorings (also known as Halas Mooring)

Suitable for: Flat bedrock

Holding capacity: Unknown – varies on the substrate

Technical expertise: It's a good idea to have someone experienced in drilled moorings to take a look at the substrate to see if its suitable. Purchasing the proper equipment requires tools, mechanics, and knowledge of engineering basics for working underwater.

Installation equipment:

- Hydraulic drill – a rotary power tool powered by hydraulic fluid or compressed air.
- Two high pressure hoses deep enough to reach the bottom.
- Quick release fittings to connect the hose & drill.
- A sturdy workboat.

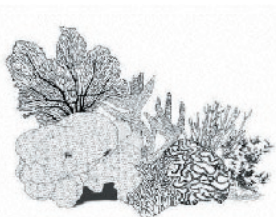
Materials: Cement, Eye Bolt, Pin, fish plate (if using more than one anchor)

Locations used include: Florida Keys National Marine Park, Saba, Cayman Islands, Hawaii, Bonaire Marine Park

Minimum installation staff: 3 people – 2 divers and 1 boat operator but 4 or 5 is preferred.

Variations: The size of the pin and the depth of the drilled whole. Eye-bolts or U-pins. Also, several drilled moorings connected together to add more strength. Different types of cement or epoxy can be used as well.

Costs: The main cost consideration for drilled moorings is the installation equipment. Cost of materials is minimal.



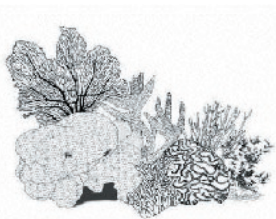
Drilled moorings (continued)

Installation:

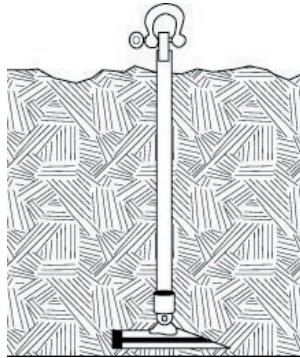
Drilling and cementing the Anchor Pin:

- 1) One person experienced in diving and installing moorings should be responsible for supervising the operation. Ideally, the work crew for drilling and cementing the moorings in place will consist of two people each. One team takes responsibility for diving and drilling underwater while a second team remains on the work boat deck. The boat team should be responsible for assisting the divers with equipment relay, operating the power unit for the drill, and mixing the cement.
- 2) Once the proper site is selected a hole is drilled into the solid substrate. Drilling time depends on the working conditions, including water depth, hardness of the substrate, experience level of the crew, mechanical difficulties experienced, and weather conditions. Weights added to the top of the drill help stabilize the drill and decrease operator fatigue. At times it may be necessary for the operator to remove the drill bit underwater to free excess or stuck sediment, so proper tools (pipe wrenches of medium to large size) should be on hand).
- 3) An 18-inch stainless steel eye pin is cemented into the hole.
- 4) Tackle is attached after cement dries (usually about 48 hours).

Source: Project AWARE's Mooring Buoy Planning Guide --"The Use of Mooring Buoys as a Management Tool: Types of Mooring Buoy Systems."



Installation Overview: Manta Ray anchors



Manta Ray Anchors

Suitable for: Sand, rubble or mud

Holding capacity: Loose sand or clay = 8 – 14,000 lbs. ; Dense sand or compact rubble = 32-40,000 lbs.

Technical expertise: It's a good idea to have someone experienced in manta moorings to take a look at the substrate to see if it is suitable. Purchasing the proper equipment requires tools, mechanics, and knowledge of engineering basics for working underwater.

Installation Equipment:

- Hydraulic jack and drive gad (pointed metal rod used to drive the anchor into the substrate)
- Load locker (or line to work boats)
- Sturdy boat

Materials: Manta Ray anchor, rod and nut, fish plate (if using more than one anchor)

Locations used include: Maui, Virgin Islands

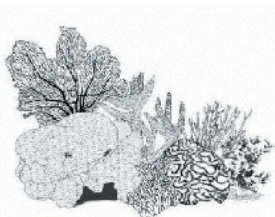
Minimum installation staff: 3 people: 2 divers and 1 boat operator, but 4 or 5 is preferred.

Variations: Size of the anchor blade. Length of the rod (3.5 – 7ft.). Extensions can be added to lengthen the rod even further. Chain may be used in place of the rod. Multiple anchors chained together to increase holding capacity. Single construction (blade and rod already attached) or separate parts which must be welded together. Length of rod should be determined by the depth of bedrock. Larger (and therefore heavier) Manta Rays are best for loose substrates.

Costs: About \$110 for an average sized anchor plus costs of rental equipment.

Installation time: about 30 minutes (Varies with conditions and substrate)

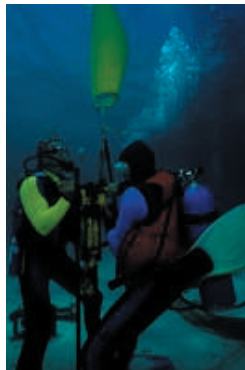
Considerations: Initial site selection is critical because once installed it cannot be moved. Holding capacity varies based on substrate.



Manta Ray Anchors (continued)

Installation:

- 1) After checking for the depth of bedrock, the anchor and rod are attached to the drive gad.
- 2) Using the hydraulic jack hammer, the anchor is driven into the substrate. The rod must be completely submerged in the sand, or will be more likely to break. If the rod cannot be completely covered with sand, it should be removed and tried in another location. If the rod is not covered with sand, it may break or bend. Some areas have replaced the rod with chain to get around this problem. If the anchor can be driven deeper into the substrate, extensions can be added. The deeper the anchor is driven the stronger the holding capacity will be.
- 3) The anchor must then be pulled upward in order to bring the blade or wing into a locked horizontal position. This can be done using a line from the boat to pull away and upwards or with a load locking device. The load locking device pulls upward on the anchor and can be used to measure holding capacity.
- 4) The mooring line and buoy can be attached immediately.
- 5) Video tapes of installation are available from Foresight Products Inc. (see Appendix)



Manta Ray installation in Florida
© Wolcott Henry 2001

Installation Overview: Helix Anchors



Helix – square shaft

Suitable for: Sand, Rubble, bedrock

Holding capacity: 20,000 lbs + in soft clay mud.
70,000 – 100,000

Technical expertise: It is a good idea to have someone experienced in helical moorings to take a look at the substrate to see if its suitable. Purchasing the proper equipment requires tools, mechanics, and knowledge of engineering basics for working underwater.

Installation Equipment: Hydraulic torque motor, sturdy work boat

Materials: Helix anchor, possibly mooring head, or eyebolts

Locations used: Bonaire Marine Park, U.S. & British Virgin Islands, Florida Keys, Belize

Minimum installation staff: 3 people – 2 divers and 1 boat operator but 4 or 5 is preferred.

Variations: Helix anchors vary in shaft diameter, and number and size of helical plates. Extensions can be used to add length and holding capacity to the anchor. Diameters: 1 3/4" and 1 1/2"

Helixes: Single, Double or Triple with diameters of 8, 10, 12 or 14" inches. For example an 8/10 Helix means that the plate on the end is 8 inches and the second plate is 10 inches.

Considerations:

- Hard substrates typically use smaller and fewer helixes while the softer soils require more, and sometimes larger helixes.
- Hard rubble coral areas typically use a lead section with a 8"-10" diameter helix and cutting teeth.
- The softer sandy sections of the reef or mooring area call for a lead section with 8, 10 or 12 in. diameter or larger helixes.
- Helical anchors can be removed and reinstalled by reversing the installation process.

Costs: Lead sections range from (\$330 - \$615) Extensions from \$80 –200. A total cost of \$700 - \$1,000)

Installation time: 15-20 minutes to install, but approximately 2 hours to set up equipment.



Helix Anchors (continued)



1. With a lift bag to control the heavy weight, a Marine Park Ranger lowers the mechanism that turns the Helix mooring into the bottom. A silhouette of the boat is visible in the background.



2. A marine park ranger positions the combination bit and mooring in a sand patch. In the background are staghorn and small head corals.



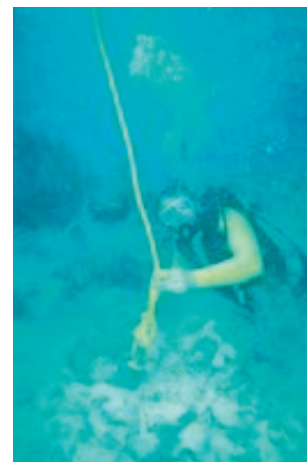
3. A park ranger and volunteer attach the bit-and-mooring combination to the mechanism, which will twist it into the substrate. Another diver hovers above, and there is some staghorn coral in the background.



4. To prevent the drilling mechanism from twisting while the bit stays still, a long bar is attached to the drill by a marine park ranger while another ranger holds the bit/mooring in position. The bar will be tied to an anchor (hand set in sand, of course) and supervised by a diver; the anchor rope and diver are partially visible at the right of the photo.

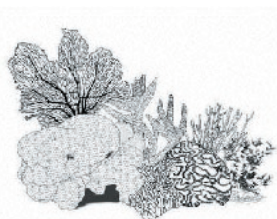


5. Two rangers hold the drilling mechanism and the combination bit and mooring, and direct the future mooring into the substrate. Some stability is provided by the lift bag, which is being monitored by a volunteer.



6. The helix mooring has been twisted almost completely into Bonaire's sand and rubble substrate, leaving just the tip and the eye through which a volunteer has just finished attaching the rope and float for the completed buoy mooring system.

Helix Anchor installation in Bonaire Marine Park. Photos and text courtesy of Dee Scarr.



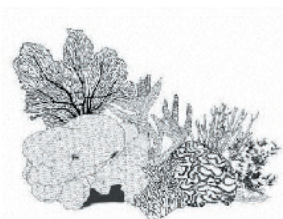
Preparing the Tackle: Downlines, surface lines and buoys

Surface lines (and downlines if the depths are known) can be prepared in advance.

The tackle can be prepared in either two or three looped sections which interlock to make it easy to install the buoy as well as take it apart for maintenance. This way one end of the rope can be threaded through the eyebolt of the mooring anchor and then the other end is threaded through the loop and run up to the surface.

At the surface, a throughline is attached the same way on one end and then threaded through the buoy on the other. The surface line is attached to the free end of the throughline. Or the throughline and pickup line can be combined. In this case the loop that attaches to the downline slips through the downline and over the entire buoy, so the loop has to be big enough to accommodate the buoy.

The length of the downline is a matter of preference. But, remember to include tide variations in your calculations.



Part IV: Maintenance

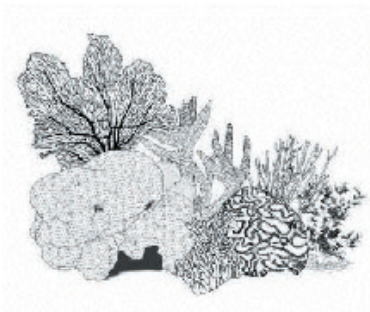
Creating a maintenance program

Mooring Buoy Disappearance and Theft:

Special strategies

Finding funding for maintenance

- Funding sources for maintenance



The basic components of a mooring maintenance program include:

- Regular maintenance.
- Periodic inspections.
- User reporting system.
- Record keeping.

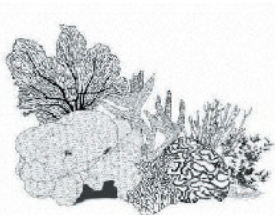
Maintenance

Keeping your moorings safe and ready to be used, means planning to maintain them. The most important components to a maintenance program are:

- **Regular maintenance** of mooring tackle (ropes and buoys).
- **Periodic inspection** of mooring hardware (weighted or drilled).
- **Reporting system** so that users can tell you about mooring wear and tear.
- **Recordkeeping system** to help with planning future maintenance and limit your liability.

You will need to think about:

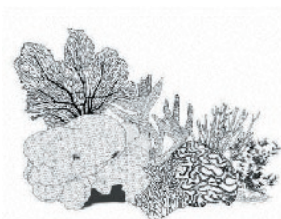
- **Who does what?** It is very important to establish some ground rules about who does mooring maintenance and how quickly. Whoever does the maintenance will need:
 - to have access to the necessary materials (lines, spare buoys, shackles and gear for cleaning).
 - to be able to get out to the mooring site to do the work.
 - necessary skills (i.e. they will have to be able to splice lines).
- **How long it will take?** Consider how long you need to repair mooring lines and buoys and guaranteeing to have essential maintenance work completed within that time—2 to 3 days would be a good turn around time.
- **How to keep records?** It is a good idea to make sure you keep detailed records about your moorings. This will help you be able to ensure that moorings are maintained on time and see if certain moorings are “problematic.” You will also be able to calculate how much maintenance is costing you per mooring (in time and material). Also, keeping good records when installing moorings, (particularly noting the location and depth for each mooring) will help you easily replace parts.
- **How to design your buoys to minimize maintenance?** Reduce maintenance needs when installing your buoys by:
 - Determining whether moorings need to be visible at night.
 - Identifying moorings—by name if possible—on site.
 - Identifying “high risk” sites that may need double lines, or more vigilant maintenance.



Maintenance programs need to be developed for your situation. You will want to think about scheduling:

- Inspection for wear and tear.
- Cleaning.
- Regular replacement of parts that wear out quickly.

Cut costs by recycling mooring lines. Longer downlines from the mooring to the surface can be reused for shorter surface pickup lines.



Creating a maintenance program

You can expect to have to perform a lot of maintenance on your mooring system when it is first established. It may take users a while to realize where the moorings are located, so you can expect to have damage to surface buoys and lines. You may also find that users initially take lines and buoys. Much of this will pass once the moorings become established in people's minds and they see the advantages of using them.

You will need to put together a maintenance program that works for your situation. The following is offered for guidance only:

Every month

- Inspect buoys for wear and tear or damage.
- Inspect lines for wear and tear.
- Clean lines and buoys as necessary.

As a rule of thumb you will want to replace lines as soon as one strand is frayed or chafed through.

Every three months

- Inspect down line (to mooring) and shackles.
- Inspect surface lines and buoys.

Every six months

- Remove and clean buoys to prevent fouling.
- Replace shackle pins on mooring.
- Inspect mooring hardware (barrel, block or pin).

Soufriere Marine Management Area, St. Lucia Mooring Maintenance Program

"Making sure that the moorings are absolutely safe is one of the most important tasks of the marine rangers. The SMMA adheres to very strict, internationally accepted maintenance schedule, specifying exactly when certain parts of the mooring system have to be inspected and changed. Every maintenance has to be recorded in a special log and all buoys must be equipped with a special tag indicating the last date of service."

Source: SMMA Website
<http://www.smma.org.lc>



Mooring Buoy Disappearance and Theft: Special strategies

If moorings are stolen:

- Switch to inexpensive materials.
- Replace them quickly.
- Use two-section downlines to cut down on replacement costs and time.
- Look for underlying problems.

One challenge of maintenance is dealing with moorings that "disappear" or are cut. It's sometimes difficult to determine the reason why this may be happening. Perhaps the mooring was cut in order to free a boat or fishing equipment or the mooring was simply stolen. Sometimes the entire tackle, downline, buoy and pickup line, are taken. In areas where reef users are unfamiliar with moorings, they may cut the mooring free because they feel that it doesn't "belong" there.

Involving all the stakeholders early on in the process can help prevent these problems but may not eliminate them. If your moorings are frequently being cut:

- Switch to inexpensive and less desirable materials, such as plastic containers.
- Plan to replace them quickly. (This will help establish moorings as "normal" for the area).
- Use two interlocking sections of rope for the downline, if the rope is being cut near the surface. You will only have to replace the section of rope closest to the surface. Or consider chain at the very top of the mooring.
- Look for underlying problems:
 - Is there too much rope floating at the surface?
 - Are the buoys visible at night?
 - Are there users who could benefit from outreach?
 - Are there hidden user conflicts? For example: Are divers cutting open fish traps, which might provoke fishermen to cut what they perceive to be the divers' buoys?
- Switch to Hawser wire for the downline.

In some areas it may take time and a few replacements before moorings are accepted.

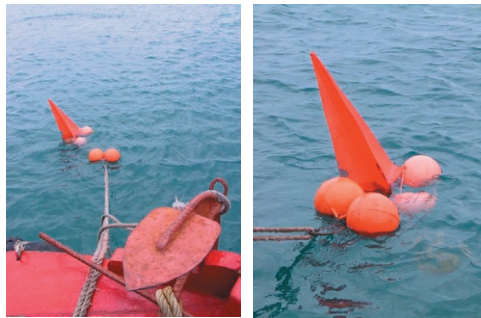
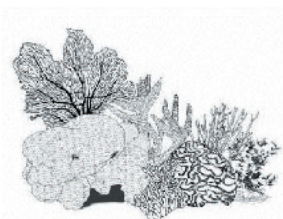


Photo by: Jamie Oliver

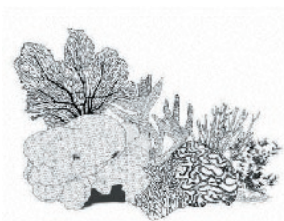
These moorings in Vietnam use Hawser wire to prevent cutting.



First step to funding mooring maintenance is to calculate your costs.

- Estimate monthly costs based on replacement of parts
- Include boat rental and staff time.
- Good records will help you better estimate costs for the future.

Moorings in areas where the sea is rough will need to be replaced more often.



Finding funding for maintenance

As well as finding funding to install the moorings you will need to have a plan for how you will fund maintenance.

How much will it cost?

In the beginning you will have to guess how much maintaining your moorings is going to cost. After the first year, of course, you will have a much better idea.

To begin with list all the materials which are likely to wear or need to be replaced out such as:

- Rope.
- Buoys.
- Chafing hose.
- Shackles.
- Moorings.

Then start to make some guesses about how much that will cost you per month, based on how often items need to be replaced:

- Pickup lines (surface): should be replace about every three months.
Calculate: $[\# \text{ moorings} \times \text{length of pickup line} \times \text{cost of line} \div 3 \text{ months} + \text{boat time}]$.
- Downlines (buoy to mooring): should be replaced every six months to a year. Use an average figure for the length of line per mooring. If your moorings are in shallow water, for example 45' – 50' might be a good average.
Calculate: $[\# \text{ moorings} \times \text{average length of down line} \times \text{landed cost of line} \div 9 \text{ months} + \text{boat time}]$.
- Chafing hose: should be replaced every six months to a year, so an average of 9 months.
Calculate: $[\# \text{ moorings} \times \text{length of hose per mooring} \times \text{cost of hose} \div 9 \text{ months}]$.
- Buoys: not too often unless you lose them but you will still need to schedule boat time to scrape and clean them
Calculate: Take an educated guess based on how many buoys you think you might lose in a year.

Finding funding for maintenance (continued)

- Shackles and moorings: Shackle pins will need to be replaced at least every six months. Shackles and moorings only need to be replaced occasionally, but they will need to be inspected and you will need to factor in boat time for that.

Calculate: While you won't want to calculate this in the beginning when your moorings are new, thinking about putting some money aside for when the moorings eventually need to be replaced is a really good idea.

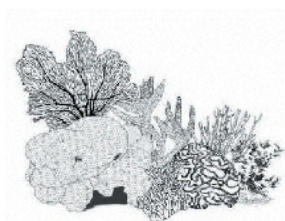
Don't forget to factor in whatever boat time costs you in terms of boat hire, staffing, fuel and running costs. Moorings located in areas where the sea is rough and moorings that receive a lot of use will cost more to maintain.

If you keep a good record of your mooring maintenance, after year one you will know how much your moorings cost to maintain.

Sample Calculations for Annual Mooring Maintenance:

Part	# of Moorings		Average Length		Cost of material		Cost of Boat time		Average # of replacements per year per buoy	Total cost per year
Pick up lines	30	✗	6m	✗	1.00	+	\$50	✗	4	\$920
Down-lines	30	✗	20m	✗	1.00	+	\$50	✗	1.5	\$975
Chafing Hose	30	✗	3m	✗	.50	+	(Already included with other parts)	✗	1.5	\$67.50
Buoys	30	✗	N/A	✗	75.00	+		✗	1	\$2250
Shackles	30	✗	N/A	✗	15.00	+		✗	1	\$450

Educating users about the rules and how to properly use the moorings will cut down on the need to replace them!

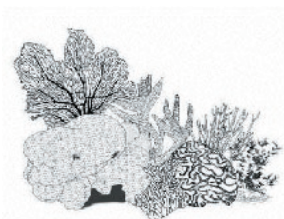


Funding sources for maintenance costs will most likely be local.

Options include:

- Per use mooring fee.
- Per year fee from companies that use moorings regularly.
- Diver admission fee to all divers.
- Mooring sponsorship program.

Press attention from scientific studies, or community activities such as photography contests can remind community donors of the need for ongoing support.



Funding sources for maintenance

Finding funding for on going maintenance costs can be tricky. You are unlikely to find a grant funding organization willing to pay for this and most likely you will be forced to find a local solution.

Think about:

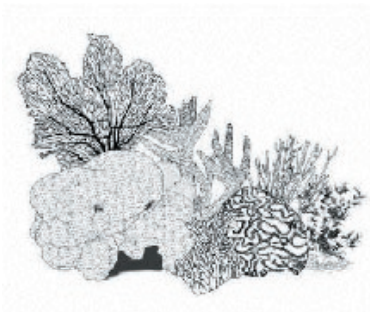
- Charging a per use fee to anyone using the moorings. While this is common for moorings used by visiting yachts to overnight on, it may be tricky to collect fees like this for day use.
- Charging a lump sum per year to all the companies which will profit from using the moorings such as dive operators, boat charters etc. Consider splitting the mooring maintenance costs proportionally between all the mooring users so that small dive operations pay less than larger ones.
- Charging diver admission fees to all visiting divers. Many coral parks already do this and part of the money is used to pay for mooring maintenance.
- Creating a mooring sponsorship program whereby individuals and organizations are encouraged to donate a fixed amount of money per year towards the maintenance of "their" mooring. This can then be acknowledged either on the mooring or shore side at an appropriate place.

Again, use your imagination and look at the solutions other local organizations such as schools and churches have found to maintain property such as playgrounds which are used "for the common good."

Part V: Appendix

Resources

Glossary



Mooring resources

U.S.

Boat Moorings.Com

P. O. Box 119
Milford, NH 03055
USA
Phone: 603.672.4619
Fax: 603.672.1751
e-mail dmerrill@boatmoorings.com
Web: www.boatmoorings.com
* Helix moorings

Environmental Moorings International

172 Lorelane Pl.
Key Largo, FL 33037-4235
USA
Phone and Fax (305) 451-
E-mail: Emilhalas@aol.com
www.reefmoorings.com
*Components for Halas System

Foresight Products, LLC

6430 East 49th Drive
Commerce City, CO
USA
Contact: International Sales Department
Tel: 303 286-8955
Fax: 303 287-3866
E-mail:
international@earthanchor.com
<http://www.earthanchor.com/>
Manta Ray

Florida Keys Marine Sanctuary

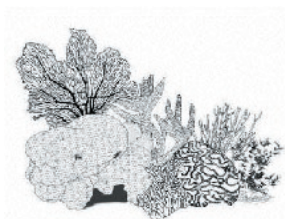
P.O. Box 1083
Key Largo, FL 33037
(305) 852-7717
<http://www.fknms.nos.noaa.gov>
*Information on Halas eyebolt system
*Mooring maintenance information available at:
<http://www.terranova.net/%7ealtmeier/noaamb/indexmb.html>

Hazelett Corp.

217 Lakeshore Dr.
P.O. Box 600 Colchester, VT 05446
(802) 863-6376
*Elastic rodes

Project AWARE Foundation

30151 Tomas Street Suite 200
Rancho Santa Margarita
CA, 92688-2125 USA
phone: 800 729 7234 Ext.2659
(US and Canada)
phone: +1 949 858 7234
Ext.2659
e-mail: information@projectaware.org
<http://www.projectaware.org>
• Small grants & mooring information
• Download the "Mooring Buoy Planning Guide" from the Project AWARE website.



Mooring resources (continued)

AUSTRALIA

Offshore Moorings

4 Stanhope St., Cottesloe WA 6011,
phone +61-(0)8-9385 1296, fax +61-(0)8-9384 0437

Environmental Moorings

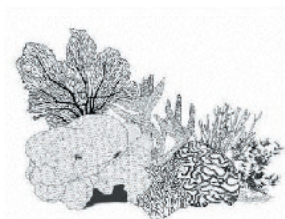
PO Box 2063
Palmyra Wa 6157
Ph 9330 5091
Mob 0411 480 480
Fax 9330 9969

Aqualib Moorings

PO Box 495
Mandurah Wa 6210
Ph 9535 6553
Mob 0417 055 553
Fax 9535 8386

Australian Mooring Services

15 Motril Ave
Cockburn Waters Wa 6166
Ph 9434 9684
Mob 0417 944 884
Fax 9418 5748



Glossary

chafing hose: Flexible plastic hose used to protect rope from chaffing. Used on the loops in downlines and on pickup lines.

chokers: A mooring which uses a rope wrapped around a natural object such as a rock or a coral head. These can do more harm than good.

concrete moorings: Mooring buoy that use a heavy concrete block to secure the mooring. If not sufficiently heavy can these blocks can be dragged from their original location and damage reefs or seagrass beds. Because concrete contains a lot of air, it can lose half its “weight” when underwater.

conventional moorings: Concrete moorings or other mooring that uses a the weight of a heavy object to secure the mooring

downline: The line that connects the mooring to the surface buoy.

drilled moorings: Moorings that are secured by a pin set in concrete in a hole drilled into the substrate. These moorings depend on the strength of the substrate and are best in flat hard bedrock.

embedment anchors: Anchors that are set deep into the substrate such as manta rays and helix anchors. They are used in soft substrates.

extension rods: Rods attached to helix anchors to allow them to be driven deeper into the substrate for more holding capacity.

grouted screw anchor: An anchor similar to the helix anchor

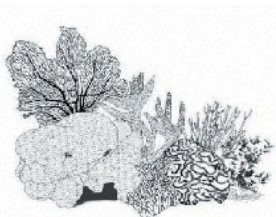
growth form: The shape of a coral such as platelike, staghorn, massive, encrusting. The same species of coral may take different forms depending on the environmental conditions. Some growth forms, such as staghorn coral, are more easily damaged by anchors.

Halas system: Mooring suitable for reef environments developed by John Halas of the Florida Keys National Marine Sanctuary to protect. The mooring consists of either a drilled or embedment base, three sections of interlocking rope with loops on both ends and a buoy.

hawser wire: Rope made of metal.

Hazlett rode: An elastic downline that helps lessen the pull on a mooring anchor.

helix anchors: An embedment anchor consisting of a steel rod with one, two or three round plates. Similar to a sand screw. This anchor can be installed in soft or semihard substrate.



Glossary (continued)

holding capacity: The amount of pull a mooring can withstand before breaking.

painter line: Also known as a pick-up line or surface line

pick-up line: Also known as a surface line, or painter line. The line that runs from the buoy with one free end for boaters to “pick-up” and tie on to the mooring buoy.

rode: See downline.

scope line: Line added from the boat to the mooring line to improve the holding capacity of the mooring.

sedimentation: The adding or stirring up of particles such as sand and silt into the water column. Sedimentation affects corals by blocking out sunlight and smothering them. Sedimentation is made worse by anchor damage.

splicing: An extremely strong type of knot where the strands of a rope are woven back into another part of the rope. Splicing is used to create loops on the ends of the pick up lines and the interlocking section of the tackle

surface line: Also known as a pick-up, that runs from the buoy with one free end to allow the boater to tie on to the mooring buoy.

tackle: the parts of a buoy that attach the anchor: the downline, throughline, buoy and surface line.

throughline: Section of rope that runs through the buoy connecting to the downline and surface line.

traditional mooring: See concrete and conventional mooring.

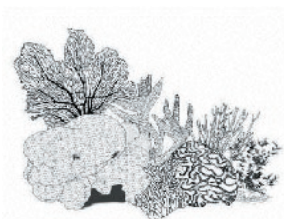
triad: three mooring anchors, such as drilled or helix, that are used together to increase the holding capacity of a mooring and to create a back-up system in case one mooring anchor breaks.

U/V treated rope: Rope that is treated to be protected from damaging sun rays. Especially useful for surface lines.

u-pin: A u-shaped pin used in drilled moorings.

wave energy: Force and movement generated by waves.

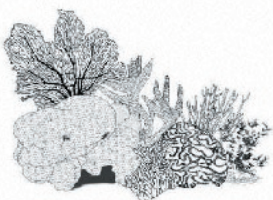
weighted anchors: See conventional mooring.



What is a coral park?

A coral park is a protected area that includes a coral reef in its boundaries and allows visitors. The coral parks program helps tourism and conservation to work in partnership for the benefit of coral reefs and the tourism industry. Learn more about where we work

For more information contact:
The Coral Reef Alliance
417 Montgomery St.
Ste 205
San Francisco, CA
94104
Tel: 415-834-0900
Fax: 415-834-0999
Email: info@coral.org
Web: www.coral.org



About the Coral Parks Program

The goal of the Coral Reef Alliance's (CORAL) Parks Program is to help coral park managers leverage sustainable tourism to build local investment in the conservation of coral reef parks. We achieve this goal by providing training, tools and resources to partners in local reef communities, including dive operators, conservation groups, and community leaders, and through our global partnership with the International Coral Reef Action Network (ICRAN). Our current geographic focus is on the Western Pacific, the Caribbean and the MesoAmerican Barrier Reef.

Training and technical assistance for coral parks: CORAL provides technical assistance and on-site training to the communities and businesses that depend on coral reefs, helping to ensure the success of local coral parks. Topics include, sustainable financing, limiting anchor damage, sustainable marine tourism, and coral reef ecology. CORAL works with marine recreation providers, bulk purchasers (such as cruise lines and tour operators), park managers, and other community members involved in the coral reef tourism industry. Through the development of partnerships between tourism and coral parks, CORAL builds cooperation that enhances both environmental and economic sustainability.

Financial support of park conservation programs: CORAL's microgrant program has provided much needed financial support to local conservation programs. Since 1995, CORAL has provided over \$350,000 in microgrants to support on the ground conservation. Currently, CORAL provides seed money to local partners participating in CORAL's training program. Through microgrants we help coral parks pay for mooring buoys to stop anchor damage, purchase functioning boats to patrol and enforce fishing rules, and publish brochures to educate visitors of park rules. Read more about past microgrant recipients.

Information and Resources: The Parks program provides tools to help park managers and communities to more effectively protect their coral reefs. Visit our website at www.coral.org for:

- * Coral Friendly Tourism Guidelines
- * Coral Reef Issue Briefs for policy makers
- * Fact Sheets for the general public
- * International Directory of Coral Reef Organizations
- * Online Coral Reef Education Materials Library